Gradient Based Optimization of Electric Machines with Analytic Sensitivities and Isogeometric Analysis

Description

Electric energy conversion is a key issue on the way to decarbonization. Computational design and optimization of electric motors is a very active research area with the aim to increase the efficiency and power density of electric drives. Yet, optimization in commercial solvers is often performed using time-consuming methods such as surrogates or genetic algorithms, taking days or weeks for one optimization.

This work combines the modeling of the motor using Isogeometric Analysis (IGA), which allows to exactly represent the geometry, with fast gradient based optimization. By using present state-of-the-art numerical modeling techniques together with efficient optimization algorithms, it is possible to reduce the optimization time to several minutes.

Work plan

- Study of GeoPDEs, Matlab's implementation of Isogeometric Analysis

- Familiarizing with the existing motor implementation and creating of a new model

- Application of analytical sensitivity analysis for parameter and/or shape optimization.

- (Comparison to optimization results of a commercial solver)

Prerequisites

- Fundamentals of the Finite Element Method

- Programming experience in Matlab or Python

- Basics of (structural) optimization are helpful

Contact:
Michael Wiesheu, M.Sc.
michael.wiesheu@
tu-darmstadt.de

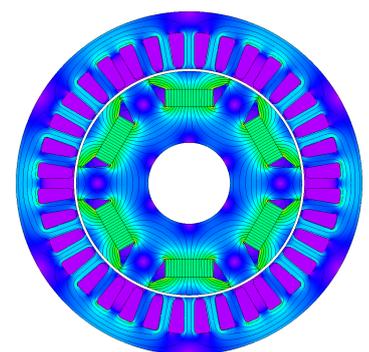Prof. Dr. Sebastian Schöps
sebastian.schoeps@
tu-darmstadt.de

Figure 1: Model of a permanent magnet synchronous motor